



Hybrid Multi-Model Assessment

When the CMM Meets ISO 9001

Robert C. Bamford and William J. Deibler II
Software Systems Quality Consulting

This article outlines a strategy and methods to employ formal appraisals to determine which model—or which elements from either model—offer the most value for a particular software engineering organization. The article is illustrated with examples from our experiences in guiding software engineering organizations to examine and select the most appropriate model for software development.

Faced with governments transitioning to commercial standards, and responding to business pressures to expand into new lines of business, many software engineering organizations are faced with adapting their CMM-based systems for ISO 9001 compliance. At the same time, many small- and medium-sized software engineering organizations are exploring methods to exploit these models for process definition and improvement. In the United States, CMM (Capability Maturity Model) to ISO (International Organization for Standardization) is emerging as the prevalent transition for government organizations and their suppliers. In Europe, because of the early adoption of ISO 9001 and ISO 9000-3, there is greater interest by commercial software development organizations in the transition from ISO 9001 to the CMM. European interest is evidenced by steadily increasing attendance numbers for the annual European Software Engineering Process Group (ESEPG) conferences sponsored by the SEI.

In response to this industry need, a number of articles and conference presentations published since 1992 [1,2,3,12] have laid a foundation for comparing the requirements of the two models. These articles and presentations provide background information useful to people who are preparing to

- Plan a transition between models.
- Identify the most appropriate model.
- Implement the most effective and efficient combination of elements from both models.

The balance of this article presents steps such people can take to translate this generic background information into a detailed, specific action plan for their organization.

Where to Start

At the beginning of the selection or transition process, there are typically champions for both models and a small group responsible for selecting a model. Whether the champions participate in the group is determined by the company culture and the willingness of the champions to participate in a process that has an uncertain outcome.

The first step in the selection or transition process is to explore and assimilate enough of the large body of knowledge to overcome initial resistance to the language and structure of ISO 9001 and ISO 9000-3 [7] or to the sheer size of the CMM—even when the focus is only on Levels 2 and 3. For organizations that persevere, the outcome of this phase is typically an understanding that both models

- Can be the basis for effective process improvement in any software engineering organization.
- Are flexible in principle, and in practice, support any software development lifecycle.¹
- Are extremely susceptible to problems introduced in the implementation (excessive bureaucracy, inflexible lifecycle definitions, over-documentation, lack of management or engineer buy-in, etc.).
- Require executive management commitment.
- Require continuing organization-wide support.

- Include regular appraisals (audits or assessments) to ensure the effective implementation and continuing relevance of the defined processes.
- Are not equivalent to each other, although ISO 9001 compliance and CMM Level 3 assessment are similar [3, 12].
- Have requirements that can be selectively implemented to satisfy the requirements of the other model. For example:
 - ISO 9001 clause 4.18, Training, maps to the requirements outlined in the Level 3, Training Program.
 - The key practices described in the Level 3 key process area (KPA), Peer Reviews, can satisfy the requirements of ISO 9001, clause 4.4.6, Design Reviews.²

Formal Appraisal

The second step in the selection or transition process is the appraisal, which creates a bridge between the available information and the impact of a model on the practices in a particular software engineering organization. The formal appraisal is a continuing opportunity to educate the organization about the content of the models, to allay concerns about bureaucracy and change, and to reinforce the credibility of the models and the appraisal process. Experience with the appraisal process also serves as a valuable input to the model selection. An appraisal is also a necessary first step in planning the introduction and implementation of any new system or process.

There are a number of well-defined, formal appraisal methods associated

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with ISO 9001 and the CMM: the ISO 9001 registration audit or pre-assessment, the Software Process Assessment (SPA), and the family of CMM-based appraisals (CBAs), which includes the Software Capability Evaluation (SCE), the CBA for Internal Process Improvement (CBA/IPI), and Interim Profiles.

ISO Registration Audits

Although the ISO 9001 audit process originally had little associated documentation, it has been well understood and consistently practiced by registrars:

- A scope is selected.
- The quality manual and supporting policy and procedural documents are reviewed.
- A plan and schedule are prepared.
- People from all levels of the organization within the selected scope are interviewed, typically at their workstations.
- The results of the audit, including a recommendation for or against registration, are consolidated into a presentation and report that is given to the managers of the audited organization.
- The report, including a recommendation for or against registration, is reviewed and approved by registrar personnel who were not involved in the audit.

The registrars' initial and surveillance audit methods have shaped the internal audits (ISO 9001, 4.17), which are periodic, mandatory self-assessments to ensure on-going compliance "with planned arrangements and to determine the effectiveness of the quality system." [6, clause 4.17]

The internal audits are critical to the management review process and to the management representative, who is responsible to "ensure that a quality system is established, implemented, and maintained in accordance with this International Standard." [6, clauses 4.1.2.3 and 4.1.3]

With the publication of ISO/IEC Guide 61 [8] and ISO/IEC Guide 62 [9] in 1996, the accreditation and the registration processes have been completely defined in standards virtually equivalent to ISO 9002. With the for-

Level 2 KPA	ISO 9001 Clause
Requirements management	4.3, 4.4
Software Project Planning	4.1, 4.3, 4.4, 4.9
Software Project Tracking and Oversight	4.4, 4.9
Software Subcontract Management	4.6
Software Quality Assurance	4.4, 4.17
Software Configuration Management	4.4, 4.5, 4.7, 4.8, 4.9, 4.12, 4.13, 4.14, 4.15

Level 3 KPA	ISO 9001 Clause
Organization Process Focus	4.9, 4.14
Organization Process Definition	4.2
Training Program	4.18
Integrated Software Management	4.4, 4.9
Software Product Engineering	4.4, 4.10
Intergroup Coordination	4.4
Peer Reviews	4.4

Figure 1. Relationship between the Level 2 and Level 3 KPAs and the ISO 9001 clauses.

malization of the role of the International Accreditation Forum (IAF), an audit structure has been implemented to monitor the on-going compliance of the accreditation bodies and registrars³ and to ensure a baseline consistency across registrations.

Because of the experience of the assigned assessors, advance preparation tends to be minimized. Typically, only the lead assessor reviews the quality manual, the top-level document, and selected policies and procedures. In the course of the on-site interviews, auditors examine process and product documentation in detail to ensure compliance with planned arrangements. ISO 9001's unique requirement that the quality policy be "understood, implemented, and maintained at all levels of the organization" [6, clause 4.1.1] has led to the practice of interviewing a sample of some 15 percent to 20 percent of the organization. Although national programs, like TickIT, include guidance (suggestions) regarding contact hours [4, section 11, p. 18], there are no international standards that define sample size and contact hours for ISO registration and surveillance audits. This has become a problem as competition forces registrars to reduce costs.

For implementation guidance, a pre-assessment by a registrar falls short. Although the registrar will be as thorough as the implementor requires, the results can only define observed nonconformity. Corrective recommendations

would be a form of consulting, which is forbidden by accreditation bodies and ISO/IEC Guide 62 as a conflict of interest that would contravene the impartiality of the assessors [9, clause 2.2.2 (o)], who would have a vested interest in their recommended solutions.⁴ As a result, a large, independent consulting community exists to provide detailed, collaborative audits, similar to the CBA/IPI (pre-assessments, gap analyses, diagnostic audits, etc.) to support implementation and action planning.

CMM Appraisal Methods

It is only since 1993 that methods like the SCE have been published. Before that, detailed information about the SCE Method was available only through SCE team training, which was available only to government teams [15, p. 28]. The Software Engineering Institute (SEI) has also published a standard, the CMM Appraisal Framework (CAF), against which any CMM-based appraisal method can be evaluated [16] and with which it has been stated the SEI-provided methods will comply.

From comments in [16, p. 25] and [17, section LA.B, p. 13] and from a wealth of anecdotal data provided by numerous people, it appears the CMM appraisal process has changed dramatically. In its initial form, the appraisal process did not rely on objective evidence or on systematic techniques to obtain evidence; the process incorporated interviews with project managers

and free-form discussions with functional area representatives. The CMM appraisal process has evolved to its present form, engaging individuals from all levels of a development organization, including middle management, and incorporating more traditional auditing methods and systematic techniques for corroboration.

This change in method, in terms of the CBA/IPI, is presented in the SEI lead assessor training [17, section LA.B, p. 13]. Key improvements are identified as

- *Documentation review.* The CBA/IPI incorporates more extensive documentation review.
- *Interviews.* The CBA/IPI includes individual interviews of project leaders, structured group interviews of middle managers, and structured group interviews of functional area representatives and individual contributors. Previously,
 - Middle managers were not necessarily interviewed.
 - Functional area representative interviews were free-form discussions.
- *Data consolidation.* The CBA/IPI incorporates more systematic analysis and consolidation of the data from the interviews and documentation review.

The CBA/IPI requires an extensive commitment from the software engineering organization undergoing the assessment. An integral part of the CBA/IPI, as a CAF-compliant method, is training for a team of members from the sponsoring organization, who participate in the assessment and who are positioned to participate in the follow-up process improvement activities. Although this commitment of resources and money has a high potential rate of return, it is typically more than can be justified by an organization investigating whether the CMM is applicable.

Key Differences Between the Appraisal Methods

Both the ISO audit and the CBA/IPI produce objective results to support process improvement. Although the two models differ in content and scope,⁵ both appraisal methods require that the

organization have completed the implementation activities necessary to define and institutionalize—implement across the organization—effective processes. The appraisal confirms the success (or continuing success) of the implementation by gathering and analyzing objective evidence. Both methods require that management invest whatever resources are required to address issues identified in the assessment or audit. There are, however, a number of key differences between the methods.

Difference 1: Level of Involvement

The most prominent difference between the ISO audit and the CBA/IPI is the level of involvement required of the organization. To position the organization to understand and take action on the findings, the CBA/IPI requires that one or more members of the organization serve on the assessment team. The comparable ISO audit relies on a representative of the audited organization (the guide), who accompanies the ISO auditor, and depends on detailed, written findings reviewed with the audited organization's management as the last step in the on-site portion of the audit.⁶

Difference 2: Interview Methods

A second difference is in how input is gathered. In an ISO audit, interviews are typically conducted in or near the interviewee's workplace and are attended by the auditor, interviewee, and the guide. In the CBA/IPI, although project managers are interviewed individually, small groups of middle managers and small groups of functional-area representatives meet with panels of assessors, chaired by the lead assessor or another member of the assessment team. The group approach is based on the principle that individual contributors will be more willing to speak frankly when they are part of a small group.

Difference 3: Reporting Results

The third difference is in how findings are reported at the conclusion of the assessment or audit. As described above, in conjunction with Difference 1, detailed, written findings are provided to and reviewed with the audited

organization's management as the last step in the on-site portion of the ISO audit, typically on the day following the last interviews. Findings are expressed in terms of a specific clause of ISO 9001 and include detailed information about the nonconformity and are classified as major or minor. The only global finding is binary. Based on the identified nonconformities, the audit team states whether it recommends that the audited organization be registered or retain its registration.

The CMM assessment concludes with presentations of draft and final findings, defining at a minimum the organization's strengths and weaknesses at the KPA level. Detailed information is transferred through the members of the organization who participate on the assessment team. In addition, a written report may be purchased as an option, but typically it is not available for an additional four to six weeks, and it does not necessarily include any significant information beyond that which was published in the final findings presentation.

Difference 4: Role of the Lead Assessor and Assessment Team Make-Up

In the CBA/IPI, preparation spans at least two weeks. Team members may lack prior assessment experience or direct experience with the CMM. In the first week, the lead assessor trains the team. In the second week, documentation is reviewed, and the assessment checklists and schedules are prepared. The lead assessor conducts key interviews, leads team interviews, and facilitates team discussions that reach consensus on findings. The lead assessor also is the CMM expert, guiding the team in its interpretation of whether observed practices satisfy the requirements of the CMM. This latter function becomes increasingly critical as the CMM is applied to commercial organizations, providing products to customers outside the Department of Defense (DoD) community. The problem of interpretation is exacerbated as commercial organizations go beyond the experience provided by many DoD software providers who have

been able to rely on CMM-compatible Military Standards, e.g., MIL-STD-2167A and MIL-STD-498, to completely define the implementation.

The CMM recognizes this problem and states that “Organizations using the key practices should be aware of these conventions (in expressing the key practices) and map them appropriately to their own organization, project, and business environment.”⁷

To mitigate the problem of auditor preconception and to enhance the maintainability of the implemented quality system, ISO 9001 requires that the organization create a quality manual, which documents how the requirements of the standard are addressed.

Difference 5: Who Appraises the Appraiser—Ensuring the Quality of the Assessments

The ISO registration process includes four levels of quality assurance:

- ISO lead auditors must complete an approved course.
- Performance of ISO lead auditors is monitored by the registrars.
- Performance of registrars is monitored by accreditation bodies.
- Performance of accreditation bodies is monitored by the IAF.

The CBA/IPI infrastructure is less extensive; the SEI is just beginning to define standards, guidelines, and a mechanism for pro-active monitoring of the quality of assessments. People with extensive experience in software development, including participation in two CBA/IPIs, can become registered lead assessors by completing the SEI curriculum and completing an assessment observed by a lead assessor. Only assessments conducted by SEI-authorized lead assessors can be recorded at the SEI as “SEI-recognized” assessments. The registry of CBA/IPI lead assessors is maintained by the SEI.

Selecting an Appraisal Method

For *CMM Level 3-compliant* or *ISO 9001-compliant* organizations, one or two people experienced in both models and familiar with the organization, and who ideally have been or have access to internal auditors or members of the

CBA/IPI team, can convert two available sources of information into an accurate benchmark of the position of the organization with respect to the other model.

The first source of information is the organization's library of presentations and reports from recent appraisals (ISO 9001: internal and registrar's audits; CMM: CBA/IPI, SCE, and SQA audits and reviews). The results of these assessments record the degree of “institutionalization” (CMM) or “effective implementation” (ISO 9001) of the required practices. The second source of information is the organization's set of documented policies, procedures, and standards, which describe in detail how the organization should operate.

Omissions identified in this conversion are addressed by updating the existing set of process documents. A by-product of the conversion is a mapping of the organization's policies, procedures, and standards to the requirements of the other model.

For *CMM Level 2-compliant organizations*, the most effective strategy depends on whether the organization is committed to the CMM and how well it is positioned for Level 3, i.e., how much groundwork has been done, exceeding the requirements of Level 2. If the CMM is well-established and the organization is well-positioned for Level 3, the recommended strategy is to continue to Level 3 and to follow the conversion strategy outlined above for a CMM Level 3-compliant organization. An alternative for a CMM Level 2-compliant organization is to commission an ISO pre-assessment and proceed with an exclusive ISO focus. To the extent that the Level 2 organization has adopted standard processes across projects (a Level 3 requirement), work products and processes will carry forward to ISO.

Organizations that are not committed to either model face the greatest challenge—and opportunity—in designing an appraisal strategy. The most straightforward approach, to undertake separate ISO and CMM appraisals, is typically too expensive, too time-consuming, and too confusing. The *hybrid model* and its associated assessment

method offer a viable alternative for the currently uncommitted organization.

Hybrid Models

A number of hybrid models exist, including Bootstrap [5, 11] and Trillium. Although these models incorporate ISO 9001, ISO 9000-3, the Malcolm Baldrige National Quality Award criteria, the CMM, and various other standards, they do not answer the needs of the organization investigating ISO 9001 and the CMM. The outputs of the appraisals associated with these hybrid models are unique to the model and do not facilitate translation among the various source models with which these proprietary hybrid models are intended to compete.

Hybrid Multi-Model Assessment

The emergence of a general agreement on the relationship between the requirements of the CMM and ISO 9001 implicitly defines another hybrid model, the union of the two models, and forms the basis for a set of assessment tools and report templates that address both the goals of the CMM KPAs and the requirements of ISO 9001.

The tools associated with the hybrid assessment address the requirements the two models share, like documented procedures for planning, and those requirements that lie outside the intersection of the two models. For example, ISO requirements for record retention, technical support, packaging and distribution, and software maintenance are not addressed in the CMM, and the CMM's detailed requirements for planning (size and cost) are not addressed in ISO 9001.

The method we adopted, a hybrid multi-model assessment, is conducted by a small team of experienced, independent assessors following standard audit practices reflected in both ISO 9001 registration audits and the SEI CAF:

- Scope selection.
- Off-site document review.
- On-site interviews.
- Report preparation and delivery of findings.

By building on the well-defined relationship between the clauses of ISO

9001 and the Level 2 and Level 3 CMM KPAs, as described in Figure 1, the results of a single set of comprehensive interviews can be presented from both an ISO 9001 and a CMM perspective. To achieve the maximum impact from the report, the findings are presented twice in separate sections. Each section of the report is organized around one of the models. Each time the finding is presented, it includes detailed recommendations for action planning and points to the sections of the other model that address similar or identical requirements. To support overall action planning, the report concludes with a single set of priorities for implementation that define the assessors' view of a logical path through the most important of the detailed findings.

Considerations for Planning Hybrid Multi-Model Assessments

A hybrid multi-model assessment can be completed by a small, independent team in approximately 140 percent of the time required for an ISO 9001 registration assessment. Based on anecdotal information and on our experience in a number of CMM-based process assessments,⁸ a hybrid multi-model assessment can be completed with 20 percent to 30 percent of the time and resources of an initial CBA/IPI.⁹

Although the proposed hybrid multi-model assessment does not include the team training that prepares the organization to act on the results of the assessment, there is implicit training in the interview process, especially when a value-added approach is used [14]. Employing collaborative assessment techniques, the hybrid multi-model assessment method is sponsored by the assessed organization and allows time in the interviews, in the entry meetings, and in general communications to solicit and deal with specific issues and concerns that might otherwise influence responses. The communications and interviews can be structured to reinforce three key principles:

- The purpose of the appraisal is to gather information to measure the completeness of the organization's

practices (what you do, not what you are supposed to do) with respect to the models.

- The purpose of measuring is to improve the organization's ability to develop and deliver software to its customers.
- Any changes or new processes introduced as a result of the appraisal must support the way the organization does or wants to do business. This principle leads to at least three corollaries:
 - Members of the organization will be required to adopt the defined processes—and alert the appropriate people if there are problems with the documented procedures.
 - The ISO 9001 and the CMM models will be used to determine only what has to be done—not how it will be done.
 - Achieving compliance with the chosen model will be a by-product of implementing effective and efficient processes that support the organization's business goals and objectives and that meet the needs of its employees.

The report derived from the assessment reinforces the similarity between the requirements both models place on a software engineering organization. The consolidated report adopts the value-added audit technique of including recommended actions, allows the champions of each particular model, who are frequently well-respected and influential engineers, to consider the other model and to leverage their experience. The recommended actions also facilitate post-assessment action planning.

After the Assessment

The assessments described in this article provide the information required to select a model—or combination of models—and to prepare a plan for effective process definition, implementation, and improvement. Achieving compliance with the chosen model is a byproduct of acting on the assessment findings.

Whether the organization's management chooses to go beyond compli-

ance to become ISO registered or to complete a formal CBA/IPI or an SCE, it is critical that management acknowledge and respond systematically to the assessment findings. In the context of ISO 9001 and CMM Levels 2 and 3, the assessment findings define problems that are adversely affecting the organization's ability to perform—that are costing the organization time and money and creating unnecessary stress. If management fails to respond, the members of the organization will inevitably draw the obvious conclusions about management's commitment to its customers and to its employees. In fact, it would have been preferable not to have conducted the appraisal.

If management responds positively, there is no guarantee of success, but that positive response may launch the organization on a path to software process improvement that will lead to increased efficiency, capability, and competitive strength. ♦

About the Authors

Robert C. Bamford, a principal of Software Systems Quality Consulting, has a master's degree in mathematics and has managed training development, technical publications, professional services, and third-party software development. His over 30 years experience include the implementation of a Crosby-based Total Quality Management System, facilitating quality courses, managing education teams, and serving on a corporate quality council. He is an active member of the U.S. Technical Advisory Group for the ISO/IEC JTC1 SC7 – Software Engineering Standards subcommittee, which is responsible for the development and maintenance of ISO 12207 and ISO 15504 (SPICE). He and William Deibler jointly developed and published numerous courses, auditing and assessment tools, research papers, and articles on interpreting and applying the ISO 9000 standards and guidelines and the SEI CMM for Software.

William J. Deibler II, a principal of Software Systems Quality Consulting, has a master's degree in computer science and 20 years experience in the computer in-

dustry, primarily in software and systems development, quality assurance, and testing. He has extensive experience in managing and implementing CMM- and ISO 9001-based process improvement in software and hardware engineering environments. He is an active member of the U.S. Technical Advisory Group for the ISO/IEC JTC1 SC7 – Software Engineering Standards subcommittee, which is responsible for the development and maintenance of ISO 12207 and ISO 15504 (SPICE). He and Robert Bamford jointly developed and published numerous courses, auditing and assessment tools, research papers, and articles on interpreting and applying the ISO 9000 standards and guidelines and the SEI CMM for Software.

Software Systems Quality Consulting
2269 Sunny Vista Drive
San Jose, CA 95128
Voice: 408-985-4476
Fax: 408-248-7772
E-mail: ssqc@concentric.net
Internet: <http://www.ssqc.com>

References

1. Bamford, R.C. and W.J. Deibler, "A Detailed Comparison of the SEI Software Maturity Levels and Technology Stages to the Requirements for ISO 9001 Registration," Software Systems Quality Consulting, San Jose, Calif., 1992.
2. Bamford, R.C. and W.J. Deibler, "Exploring the Relationship Between ISO 9001 and the SEI Capability Maturity Model for Software Engineering Organizations," *Proceedings of the 1993 International Conference on Software Quality*, Lake Tahoe, Oct. 4-6, 1993, The Software Division of the American Society for Quality Control, p. 199.
3. Bamford, R.C. and W.J. Deibler, "Comparing, Contrasting ISO 9001 and the SEI Capability Maturity Model," *COMPUTER*, IEEE Computer Society, October 1993, p. 68.
4. Gilbert Associates (Europe) Limited, "TickIT Auditor Training Course," Issue 1, April 1992.
5. Hasse, Volkmar, Richard Messnarz, and Robert M. Cachia, "Software Process Improvement by Measurement," BOOTSTRAP/ESPRIT Project 5441.
6. "ISO 9001, Quality Systems – Model for Quality Assurance in Design/Development, Production, Installation, and Servicing, ISO 9001, International Organization for Standardization (ISO), Geneva, Switzerland, 1987, revised 1994.
7. "ISO 9000-3, Guidelines for the Application of ISO 9001 to the Development, Supply and Maintenance of Software," ISO, Geneva, Switzerland, 1991.
8. "ISO/IEC Guide 61, General Requirements for Assessment and Accreditation of Certification/Registration Bodies," 1st ed., Geneva, Switzerland, 1996.
9. "ISO/IEC Guide 62, General Requirements for Bodies Operating Assessment and Certification/Registration of Quality Systems," 1st ed., Geneva, Switzerland, 1996.
10. Kasse, Tim, and Wihalm Josef, "The Long Way to CMM Level 4," *Proceedings of the First World Congress for Software Quality*, American Society for Quality Control, June 1995.
11. Kuvaja, Pasi, et al., *Software Process Assessment and Improvement – The Bootstrap Approach*, Blackwell Publishers, Oxford, England, 1994.
12. Paulk, Mark C., "A Detailed Comparison of ISO 9001 and the Capability Maturity Model for Software," *Software*, January 1994.
13. Paulk, Mark C., et al., *Key Practices of the Capability Maturity Model*, Version 1.1, CMU/SEI-93-TR-25, SEI, CMU, Pittsburgh, Pa., March 1993.
14. Sayle, Allan J., *Management Audits – The Assessment of Quality Management Systems*, (ISBN 0-9511739-1-X), ASQC Press, 1989.
15. CMM-Based Appraisal Project, *Software Capability Evaluation, Version 2.0, Method Description*, CMU/SEI-94-TR-6, SEI, CMU, Pittsburgh, Pa., 1994.
16. Masters, Steven and Carol Bothwell, *CMM Appraisal Framework, Version 1.0*, CMU/SEI-95-TR-001, SEI, CMU, Pittsburgh, Pa., 1995.
17. *CBA Lead Assessor Training, Participant's Guide, Version 1.1a*, SEI, CMU, Pittsburgh, Pa., April 1997.
1. Documents associated with both models contain explicit statements of principle regarding lifecycle independence. For ISO [7], paragraph 5.0 states that the standard is "intended for application irrespective of the lifecycle model used." For the CMM [13], paragraph 4.3.5 states that "the key practices are not meant to limit the choice of a software lifecycle. ... There is no intent to encourage or preclude the use of any particular software lifecycle."
2. The requirements for verification assigned to the software quality assurance function by the CMM can be satisfied by ISO 9001 internal audits.
3. "Current and Potential Role of QSAR," *Quality Systems Update*, June 1995, p. 5 and "ISO Decides Fate of QSAR," *Compliance Engineering Newswatch*, July/August 1997 (<http://www.ce-mag.com/isojul.html>). At the time this article is being written, the IAF is seeking incorporation.
4. It is interesting to note that although ISO 9000 accreditation bodies do not consider training to be a consulting activity, QS9000 expressly forbids both training and consulting.
5. [1], [2], and [3] contain the background for our conclusion that the two models produce comparable results when adopted by a software engineering organization. One of the key differences is in the ability to extend ISO 9001 to all parts of an organization, e.g., marketing, sales, program management, systems engineering, and system test.
6. The results presented by the audit team are submitted to the registrar's "home office" for review before they become official.
7. [13], paragraph 4.1. It is of interest to note that there is an analogous statement in ISO 9001. In the Introduction, [6] states, "It is not the purpose of these [standards] to enforce uniformity of quality systems. ... The design and implementation of a quality system will be influenced by the varying needs of an organization, its particular objectives, the products and services supplied, and the processes and specific practices employed."
8. We have participated in CBA/IPIs and conducted Hybrid Maturity Model assessments in organizations ranging in size from 100 to more than 800 employees. This size estimate is also consistent with [10], page 15.
9. Note that the initial CBA/IPI considers all the Level 2 KPAs and a number of Level 3 KPAs.

Notes

1. Documents associated with both models contain explicit statements of principle regarding lifecycle independence. For ISO [7], paragraph 5.0 states that the standard is "intended for application